

# Logic

# Rational thought

Do animals have logic reasoning?

# Logic and language

Is language essential for  
rational thought?

Do some species have our  
capacity for rational  
thought?

Some other communication  
systems express the same  
mental processing (language) in  
very different ways?

# How do we test animal's capacity for logic, reasoning?

1. Teach animals our kind of language system (anthropomorphism?).
2. Whether animals categorize, formulate concepts in nature?

# Logic: categorization

A is A

A is not not-A

Everything is either A or not-A

# 1. Can pigeons categorize and deduce what they have in common?

Visual categorization:  
Lab-raised pigeons to  
slides of various  
scenes: operant  
learning



# Pigeons: categorize trees?



Pigeons create a rough mental category for trees by visual learning

Or: Innate representation of trees?

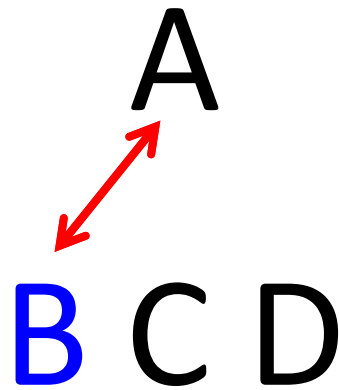


# Logical thought

$$X = Y$$

$$Y = Z$$

Therefore,  $X=Z$



$A = B$

$B = Z$

$Z = A$

Rewarded for choosing  
A when B is presented

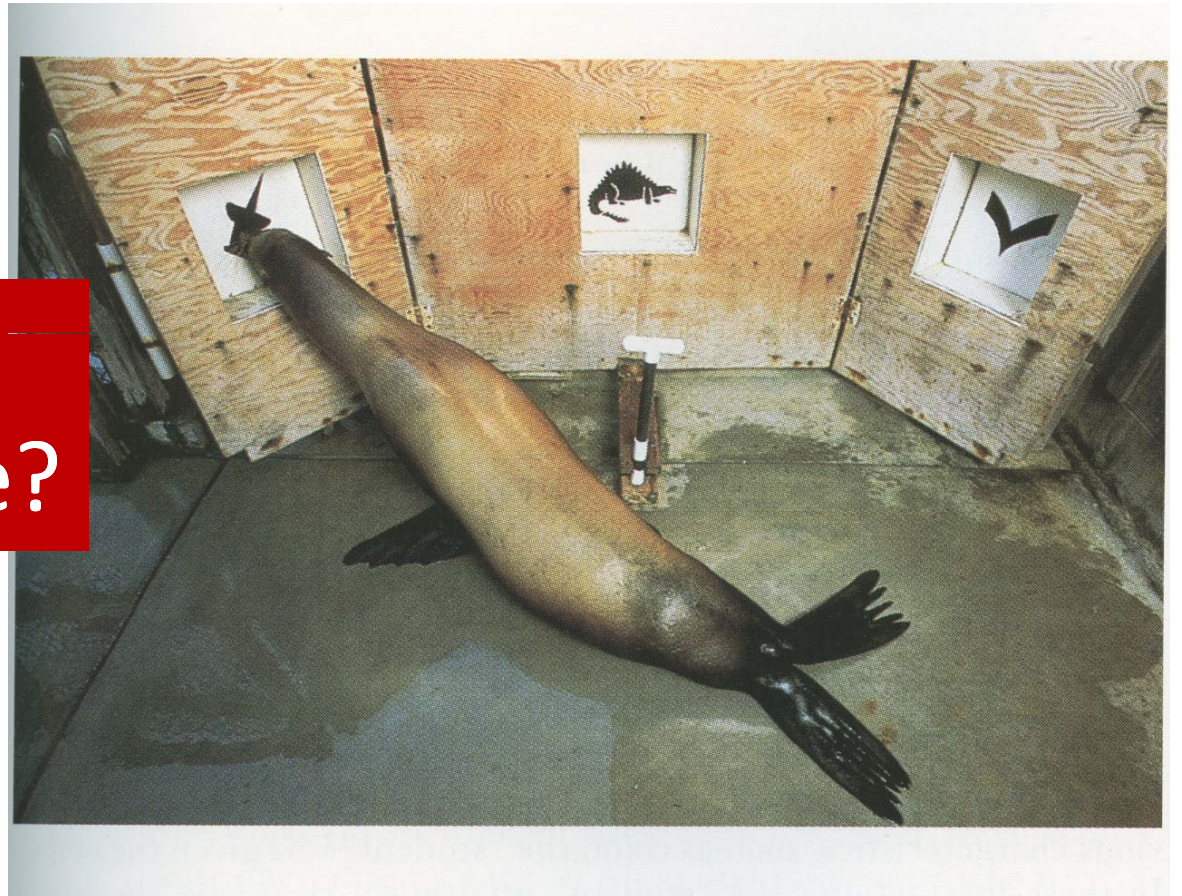
Rewarded for choosing  
B when Z is presented

# Logical thought of sea lion



# Logical thought

Logic does not  
require language?

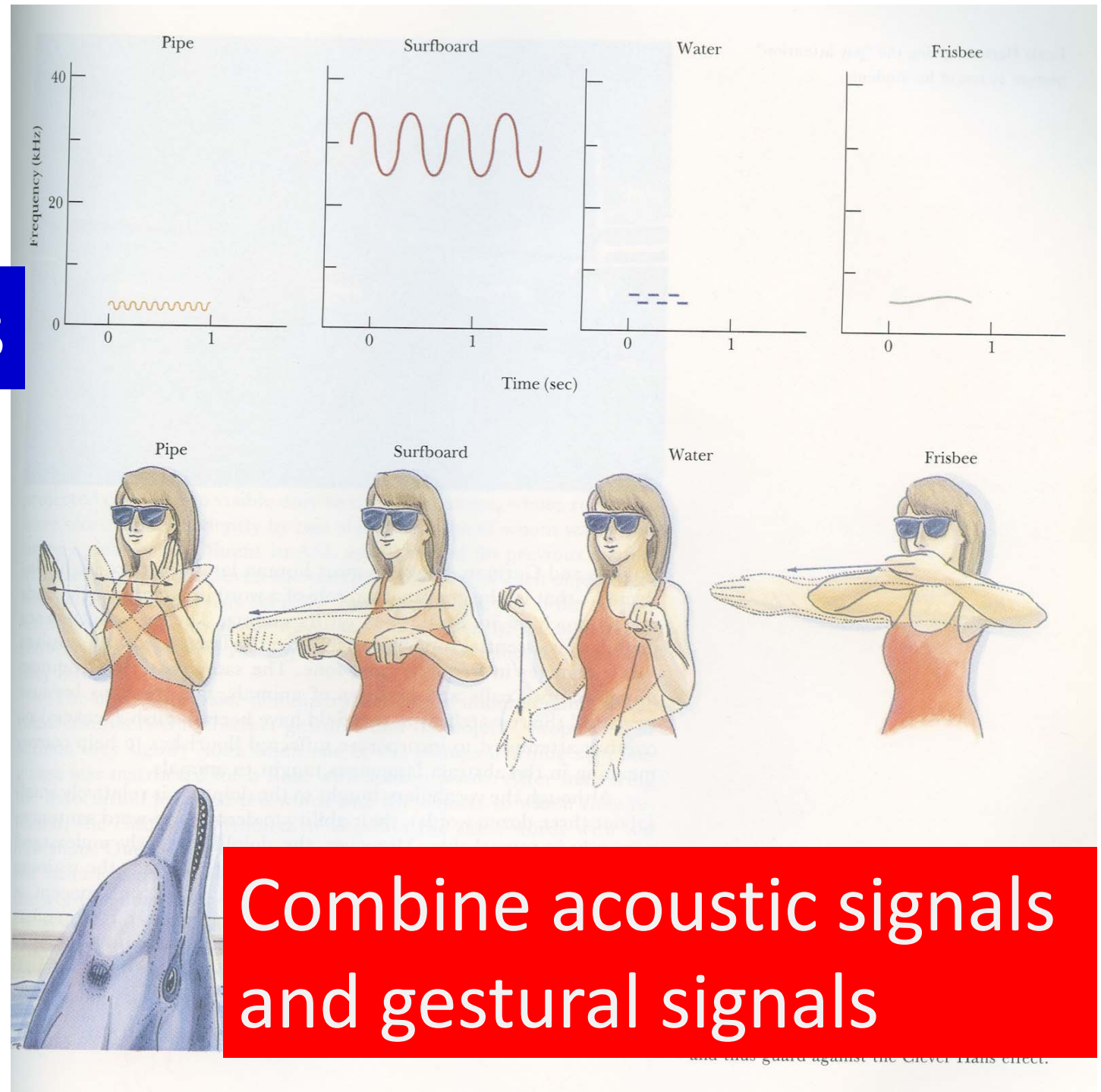


# Gesture language





# Dolphins





Gesture language  
(one-way signal)

Gesture= words  
Sequence of gesture= sentence

# Word-order grammar



Subject-adjective, subject-  
noun, **verb**, object-adjective,  
object-noun

Bottom pipe **place in** surface  
hoop



# Word-order grammar



Subject-noun, subject-  
adjective, object-noun,  
object-adjective, verb

Pipe bottom surface hoop  
place in

# Dolphins understand language?

Surfboard Person Fetch means:

"take the person to the surfboard,"

Person Surfboard Fetch means the opposite, -

"take the surfboard to the person."

Requires the dolphin to receive and process the entire sequence before it can reliably interpret the instruction and respond

Right Basket Left Frisbee In means, "Put the Frisbee on your left in the basket on your right."

# Gestural language in dolphins

1. decode 5-word sentence
2. understand what the words signal



# Gestural language in chimpanzees



Washoe: 130 words-4 years  
(1965-2007)

## Use American sign language

# Gestural language in chimpanzees

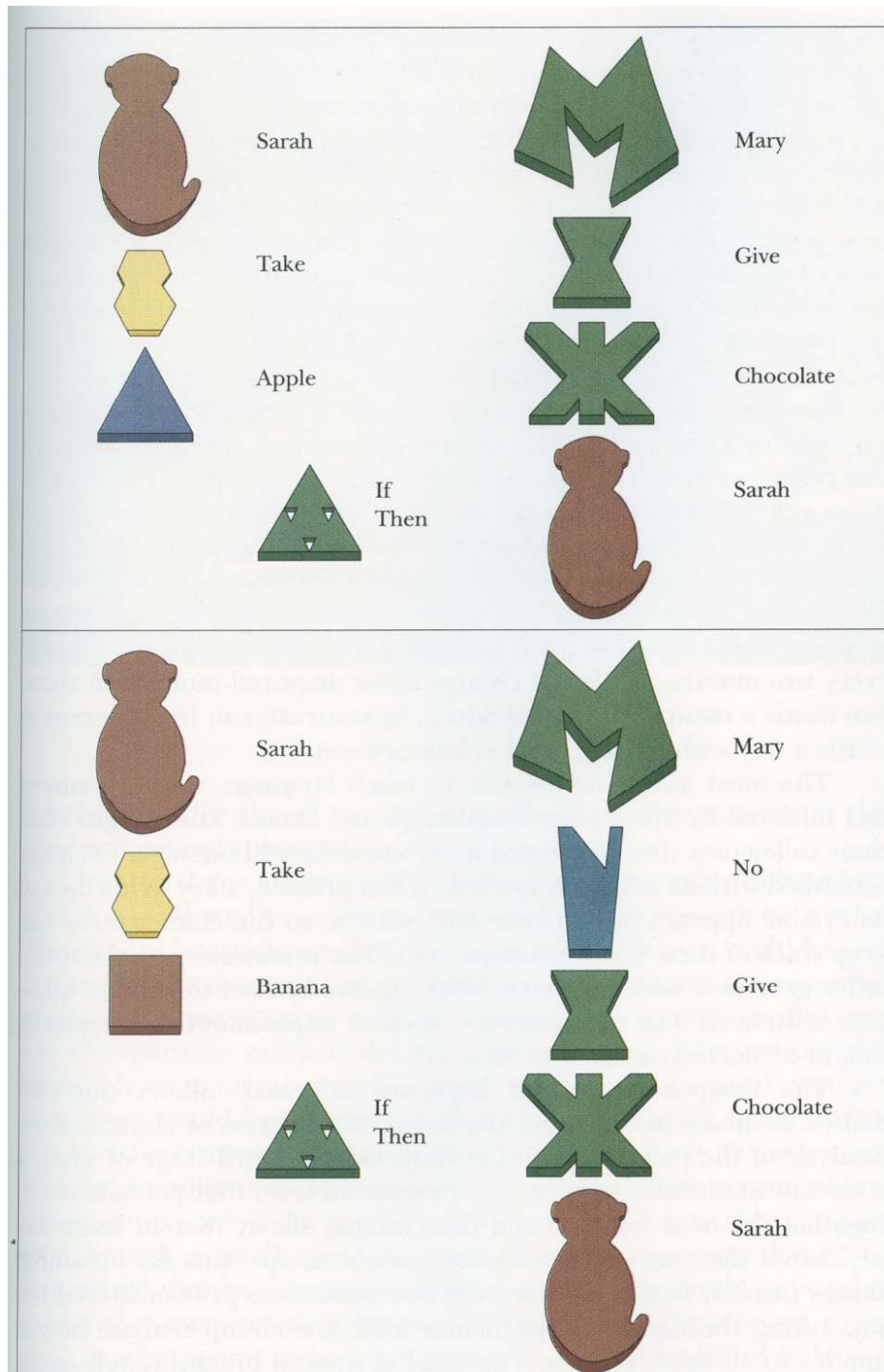


1. Associate 10 words → 10 objects
2. Associate the same 10 words → 10 new signs
3. Present one object to chimp  
→ show the signs

# Symbol-based language learning in chimpanzees

Lexigrams-  
use colorful plastic shapes as words





After the chimpanzee Sarah was taught to use a language based on plastic shapes, she learned to interpret conditional sentences. The first sentence reads, "If Sarah takes the apple, then Mary will give chocolate to Sarah"; the other, more sinister, outlines a different consequence: "If Sarah takes the banana, Mary will not give chocolate to Sarah."



Sarah



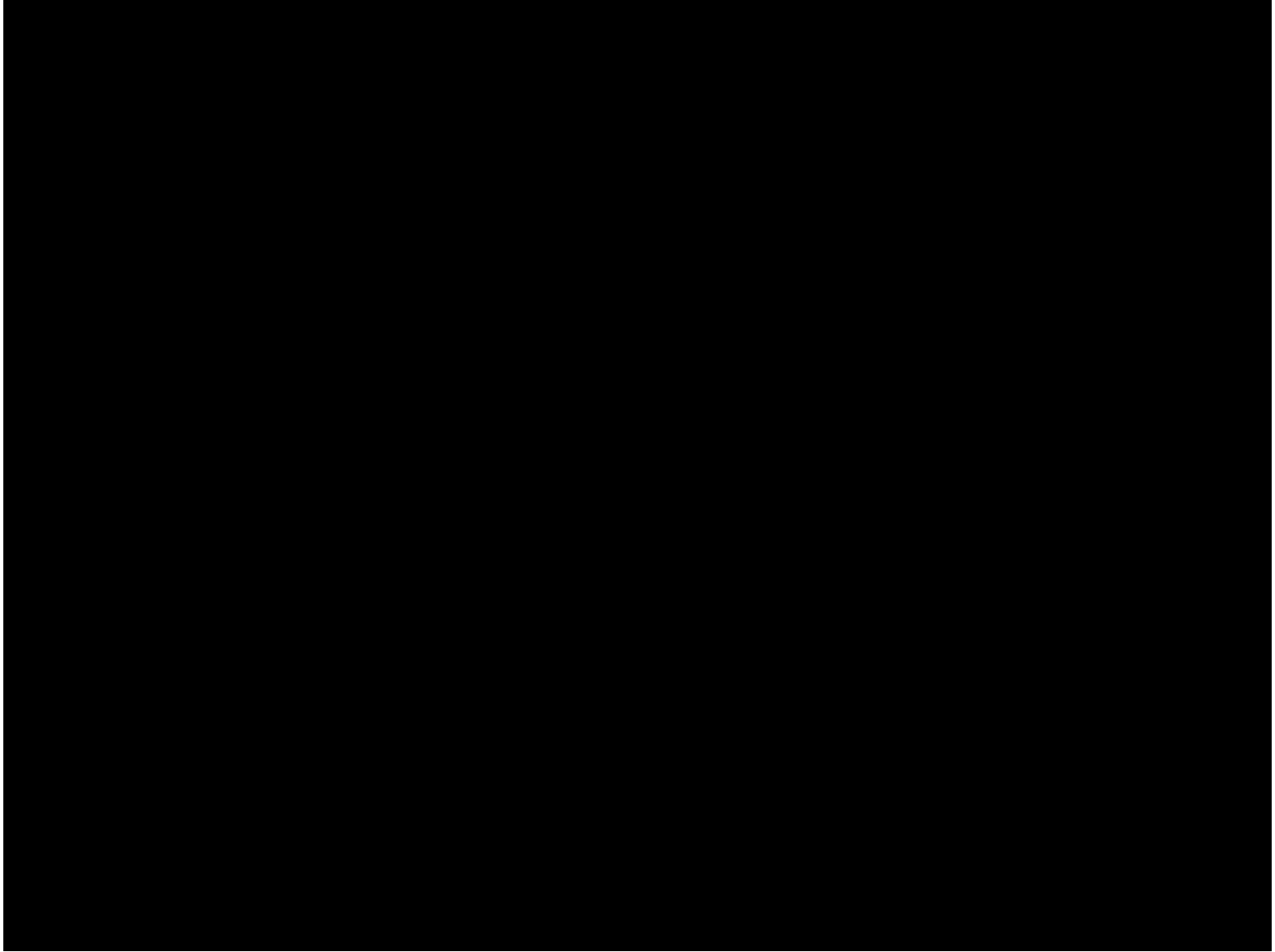
# Keyboard-based language



Allow two chimps to communicate with each other

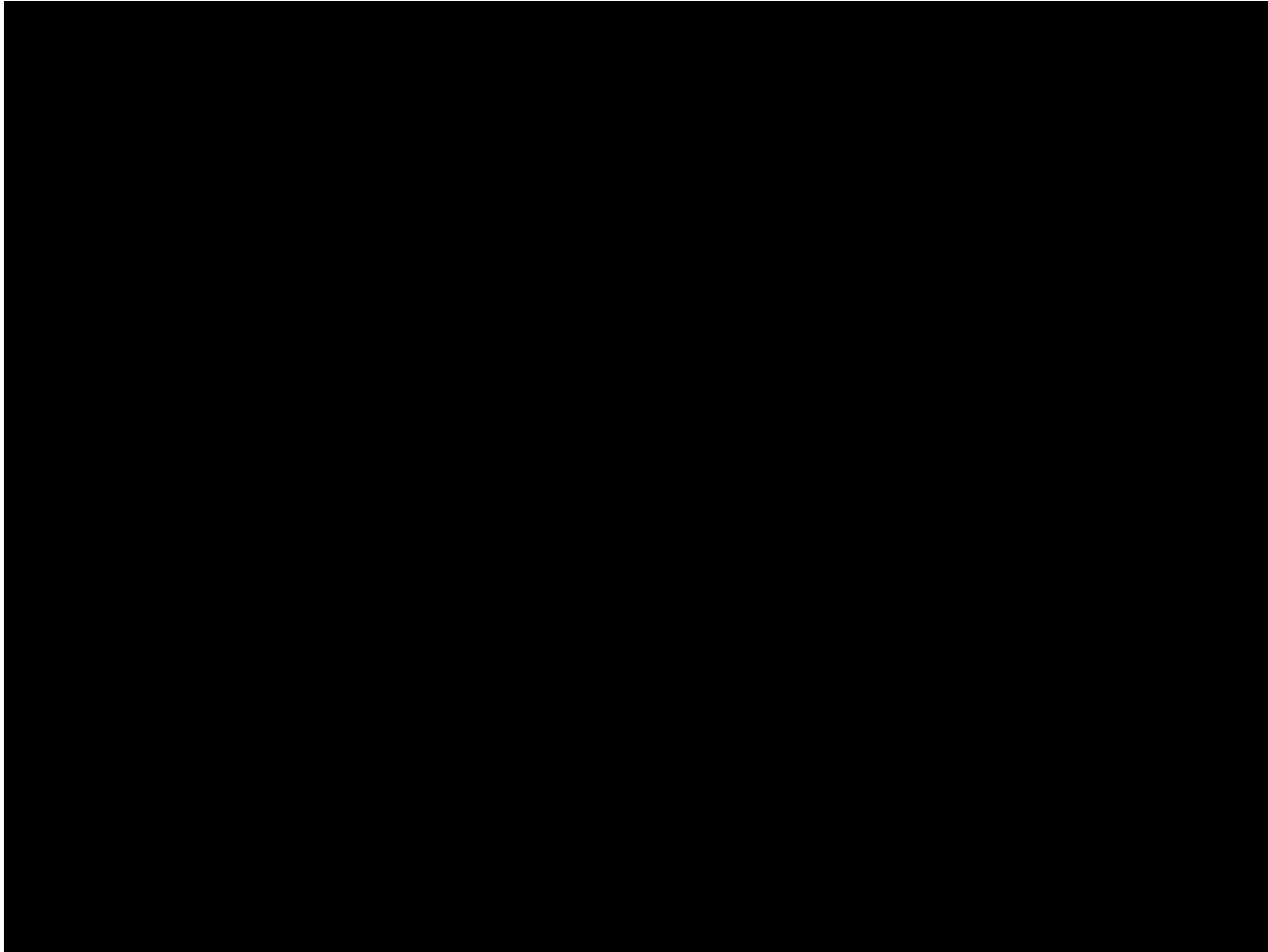


# Kanzi (Bonobo)



Knows >3000 words?

# Kanzi



Understand the symbols and their use as tools for exchanging information and communication of intentions.

No other species use our  
sort of language

Is language essential for  
rational thought? **No**